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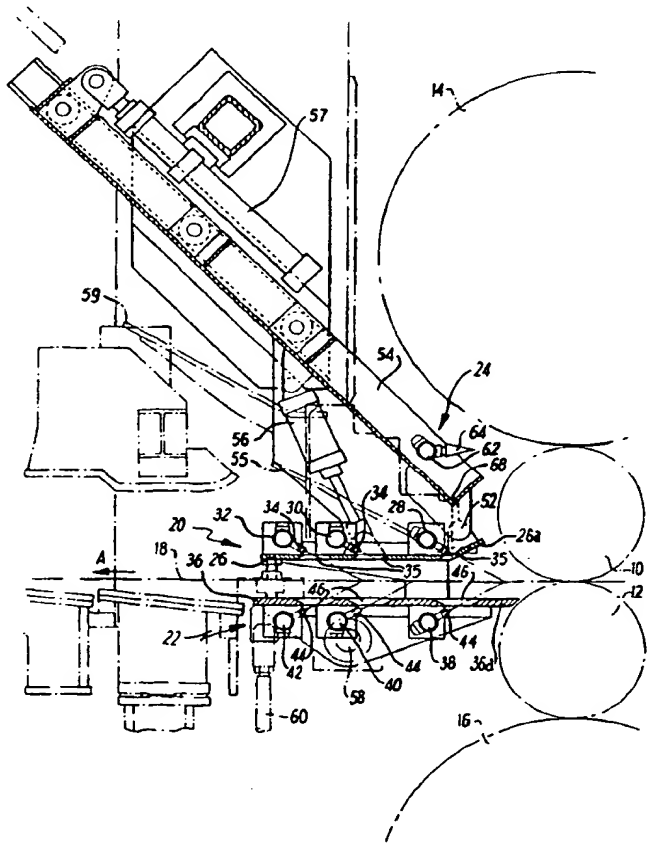
(54) Title: APPARATUS FOR USE IN ROLLING MILLS

(57) Abstract

Strip material moves along a pass line (18) through work rolls (10, 12) of a rolling mill. The strip is sprayed with a lubricant before contacting the work rolls (10, 12). Apparatus for removing the lubricant and drying the strip after rolling and before reeling uses air jets produced by nozzle assemblies (20, 22) above and below the pass line (18). The nozzle assemblies (20, 22) are located in close proximity to the pass line (18). The air jets are substantially confined by wall elements lined with energy absorbing material (Fig. 4). The nozzle assemblies (20, 22) are mounted so as to be readily movable out of the vicinity of the roll stand.



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"Apparatus for use in Rolling Mills"

This invention relates to apparatus for use in rolling mills for the purpose of removing fluids from the strip surface at the exit side of the roll stand.

In the cold rolling of aluminium strip, it is conventional to use a liquid lubricant such as kerosene which is sprayed onto the strip at the input side of the roll stand. It is desirable to remove the lubricant and thus dry the strip before the rolled strip is reeled; failure to do so may lead to the lubricant, or more especially contaminants carried by the lubricant, causing staining or spotting of the strip.

It is known to remove the lubricant by directing jets of compressed air at the top and bottom surfaces of the strip as it exits the roll stand. However, the known apparatus for achieving this have not been entirely satisfactory in achieving the desired quality of the finished strip, and also have a significant disadvantage of producing a large volume of spray or mist of lubricant in the area of the roll stand.

An object of the present invention is to provide an

improved apparatus in which the foregoing disadvantages are overcome or mitigated.

Accordingly, the present invention provides apparatus for use in removing a lubricant from the surface of strip exiting from a roll stand of a rolling mill, the apparatus comprising upper and lower nozzle assemblies positioned above and below the strip path to project a pressurised fluid onto the upper and lower surfaces of the strip in a direction towards the roll stand exit and at a vertical angle which forms an acute angle with the strip path the nozzle assemblies being positioned adjacent the strip; and the apparatus further including confinement means positioned around the discharge of the nozzle assemblies to confine within the vicinity of the strip at least a substantial portion of any lubricant forced off the surface of the strip by the pressurised fluid.

Preferably, said pressurised fluid is air and said lubricant is a liquid.

Preferably, the apparatus includes a further nozzle assembly positioned to direct pressurised air into the bite between an upper work roll and an upper backup roll of the roll stand.

In a particularly preferred form of the invention, the containment means includes carrier plates for the nozzles and end plates, and at least part of the interior surface of the containment means is provided with an energy absorbing material, suitably in the form of wire mesh.

The nozzles are preferably arranged so as to create one or more transverse rows of fluid impact areas which are

positioned so as to extend across the width of the strip but without the impact areas overlapping.

The nozzle assemblies are preferably mounted in such a manner as to be closely adjacent the strip path and the roll stand exit when in use, while being readily moved to inoperative positions allowing easy access to the roll stand exit area.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional side view of apparatus forming one embodiment of the invention and part of an associated roll stand of a rolling mill;

Fig. 2 is a plan view of an air nozzle assembly used in the apparatus of Fig. 1, illustrating the jet pattern produced by the air nozzle assembly;

Fig. 3 is a plan view of another air nozzle assembly used in the apparatus of Fig. 1; and

Fig. 4 is a schematic end view of the apparatus of Fig. 1.

Referring to Fig. 1, the apparatus of the present embodiment is used in conjunction with a roll stand having upper and lower working rolls 10 and 12 and upper and lower backup rolls 14 and 16. The strip travels through the roll stand along the path indicated at 18 in the direction of the arrow A. The rolling mill itself may be any conventional mill and is therefore shown in outline in sufficient detail only to indicate the relationship between the mill and the

apparatus of the present invention.

Lubricant is sprayed onto the strip in well known manner at the entrance side to the roll stand by means not shown. The apparatus of Fig. 1 is used to remove the lubricant and dry the strip before the latter is reeled on a reel stand (not shown).

The apparatus includes an upper nozzle assembly 20 and a lower nozzle assembly 22 disposed above and below the strip path. These assemblies are supplied with pressurised air which is blown onto the strip, in a manner to be described in greater detail below, so as to blow the lubricant to the sides of the strip and from there to blow it clear of the strip. The apparatus also includes a backup roll nozzle assembly 24 which directs pressurised air at the bite between the upper work roll 10 and the upper backup roll 14, as will also be described in greater detail below.

The upper nozzle assembly 20 comprises a carrier plate 26 on which are mounted three header bars 28, 30, 32 extending transversely of the strip. Each header bar 28, 30, 32 mounts a number of nozzles 34 directed towards the top surface of the strip via apertures 35 in the carrier plate 26. Similarly, the lower nozzle assembly 22 comprises a carrier plate 36 mounting header bars 38, 40, 42 carrying nozzles 44 directed at the bottom surface of the strip via apertures 46.

Each of the header bars is supplied with dry pressurised air via suitable hoses (not shown), and the pressurised air is discharged through the nozzles 34, 44 to remove lubricant from the strip. As seen in Fig. 1, the nozzles 34, 44 are disposed to discharge air at a vertical angle α which is typically in the range 25°

to 35°.

Fig. 2 illustrates the disposition and effect of the nozzles 34 on one header bar 28; the other header bars are arranged in an identical manner. The nozzles 34 (in this embodiment, nine nozzles on each header bar) are disposed at varying horizontal angles to the strip axis to produce air contact areas 48 on the strip 50 of generally elliptical shape and at varying angles to the strip axis across the width of the strip. This pattern promotes flow of the lubricant to the sides of the strip and thereafter detachment of the lubricant from the sides of the strip. It will also be noted that the air contact areas 48 overlap across the width of the strip, but do not mix with each other. This arrangement ensures that the whole width of the strip is wiped while avoiding turbulence which would be produced if the discharge from adjacent nozzles were allowed to mix.

This pattern of air impact can suitably be produced by nozzles having discharge openings of rectangular shape, typically about 15 mm x 5 mm, supplied with air at a pressure of the order of 4 - 5 bar.

Referring again to Fig. 1, the upper carrier plate 26 is hinged at 52 to a support member 54 and may be pivoted about 52 to a position shown at 55 in phantom by operation of an air cylinder 56. The support member 54 in turn is mounted for sliding movement by a hydraulic cylinder 57 to an upper position shown at 59 in phantom. The lower carrier plate 36 is pivotally mounted at 58 about which point it may be swung anticlockwise by a hydraulic cylinder or the like (not shown) operating through a connecting rod 60, after the upper assembly has been withdrawn, into a substantially

vertical position. These movements of the upper and lower assemblies take the present apparatus out of the immediate vicinity of the roll stand in a simple and convenient manner, to allow work to be carried out on the roll stand such as changing rolls.

This mounting arrangement also has the advantage that, in the event of a misfeed of the strip in the exit area of the roll stand, the nozzle assemblies can readily be swung clear to provide access for remedial action.

The support member 54 also acts as a mounting for the backup roll nozzle assembly 24. The assembly 24 comprises a header bar 62 which is rotatably mounted in the support member 54 and may be angularly adjusted (by means such as a hand-driven rack and pinion, not shown) to be aimed accurately at the bite between the upper backup roll 14 and the upper work roll 10. The header bar 62 carries a number of nozzles, as seen in Fig. 3, comprising a central, fishtail shaped nozzle 64 and angled side nozzles 66. The purpose of the assembly is to avoid a build up of lubricant in the bite area which would tend to be scattered or sprayed by the rotation of the rolls. The angular adjustment of the assembly 24 allows it to be aligned with rolls of different sizes, or to be adjusted to cope with wear of the rolls.

The support member 54 is formed in this embodiment as an open-topped tray, which assists by intercepting lubricant drops or mist which would otherwise fall towards the strip, the intercepted lubricant then being discharged by gravity through drain holes such as 68.

In the present embodiment, the upper and lower nozzle assemblies 20 and 22 are positioned in close proximity to the strip 50, typically in the range 50 - 250 mm and

preferably about 150 mm; this contrasts with prior art arrangements in which air nozzles are typically directed at the strip from a distance of the order of 1 m. This allows a much more accurate air blast pattern and reduces the spread of lubricant spray and droplets. The lubricant is further confined by substantially enclosing the area of the nozzle assemblies. As best seen in Fig. 4, the area in question is closed at the sides by side plates 70 and at the top and bottom by the carrier plates 26 and 36. The upstream end of this area in the embodiment of Fig. 1 is confined by a forward extension 36a of the lower carrier plate 36 configured to act as a stripper bar on the lower work roll 12, and an end portion 26a projecting from the upper carrier plate 26 towards the upper work roll 10. In an alternative, shown schematically in Fig. 4, the upstream end of this area is confined by a pair of vertical end plates 72 and 74 forming a narrow slot 75 for passage of the strip. A similar arrangement may be disposed at the downstream end of the area.

This arrangement substantially reduces the general spread of lubricant spray or droplets. It is however possible for such lubricant to bounce from the confinement back onto the strip. To overcome this problem, it is preferred to line at least part of the area with an energy absorbent material as indicated at 76 in Fig. 4. The material 76 should be such as to absorb the kinetic energy of impacting lubricant so that the lubricant is retained in the area of the wall and runs by gravity to a suitable discharge. A preferred material for this purpose is a mesh of fine stainless steel wire, but other material may be used, such as bristles of metal or plastics which are resistant to the lubricant material and the temperature

of operation.

The invention is of particular usefulness in the cold rolling of aluminium strip, and has been shown to give excellent results in rolling aluminium strip in widths of 0.9 m - 2.0 m in finished thicknesses down to 0.2 mm. It is believed that the invention would be useful also in other rolling processes such as the cold rolling of steel strip.

Modifications may be made to the foregoing embodiment within the scope of the invention.

For example, the air nozzles in a given transverse row of nozzles may be supplied with pressurised air independently, instead of via a common header. This makes it possible to use different pressures at different locations across the width of the strip, suitably a higher pressure in the centre and progressively lower pressures towards the sides. It also makes it possible to disable the air supply to the outer nozzles when rolling strip of a width less than the full width capacity of the mill, thereby saving on compressed air consumption.

The upper and lower nozzle assemblies may be constructed so that the vertical and horizontal angles of discharge of the nozzles may be adjusted. This simplifies adjusting the apparatus to deal with different thicknesses and widths of material.

CLAIMS

1. Apparatus for use in removing a lubricant from the surface of strip exiting from a roll stand of a rolling mill, the apparatus comprising upper and lower nozzle assemblies positioned above and below the strip path to project a pressurised fluid onto the upper and lower surfaces of the strip in a direction towards the roll stand exit and at a vertical angle which forms an acute angle with the strip path the nozzle assemblies being positioned adjacent the strip; and the apparatus further including confinement means positioned around the discharge of the nozzle assemblies to confine within the vicinity of the strip at least a substantial portion of any lubricant forced off the surface of the strip by the pressurised fluid.

2. Apparatus according to claim 1, in which said pressurised fluid is air and said lubricant is a liquid.

3. Apparatus according to claim 2, including a further nozzle assembly positioned to direct pressurised air into the bite between an upper work roll and an upper backup roll of the roll stand.

4. Apparatus according to any preceding claim, in which the upper nozzle assembly includes a plurality of nozzles mounted on an upper carrier plate, and the lower nozzle assembly includes a plurality of nozzles mounted on a lower carrier plate, each nozzle projecting pressurised fluid via a corresponding aperture in the respective plate; and in which the containment means comprises said carrier plates and end plates on either side of the strip path.

5. Apparatus according to claim 4, in which at least part of the inner surface of the containment means is provided with an energy absorbing material.

6. Apparatus according to claim 5, in which said energy absorbing material is a layer of wire mesh.

7. Apparatus according to any preceding claim, in which each of the upper and lower nozzle assemblies comprises at least one row of nozzles disposed transverse to the strip axis, the nozzles in the or each row being so formed and positioned as to produce on the surface of the strip a series of impact zones of pressurised fluid extending generally transversely of the strip at varying shallow angles to the transverse direction of the strip so as to overlap in the transverse but not in the axial direction of the strip.

8. Apparatus according to claim 7, in which each of the upper and lower nozzle assemblies comprises three transverse rows.

9. Apparatus according to claim 7 or claim 8, in which each transverse row comprises a number of nozzles mounted on and fed from a transverse header bar at a common pressure.

10. Apparatus according to claim 7 or claim 8, in which the pressure of fluid supplied to the nozzles of a given row may be varied across the width of the strip.

11. Apparatus according to any preceding claim, in which the upper and lower nozzle assemblies are mounted on upper and lower support means each movable between an operative position in which the nozzles are closely

adjacent the strip path at the exit from the roll stand and an inoperative position allowing access to said exit.

12. Apparatus according to claim 11, in which the upper nozzle assembly is pivoted on a support member disposed above at an angle to the strip path, and the support member is movable toward and away from the roll stand.

13. Apparatus according to claim 3 and claim 12, in which the support member carries said further nozzle assembly.

14. Apparatus according to claim 13, in which the support member is in the form of an tray open towards the upper backup roll.

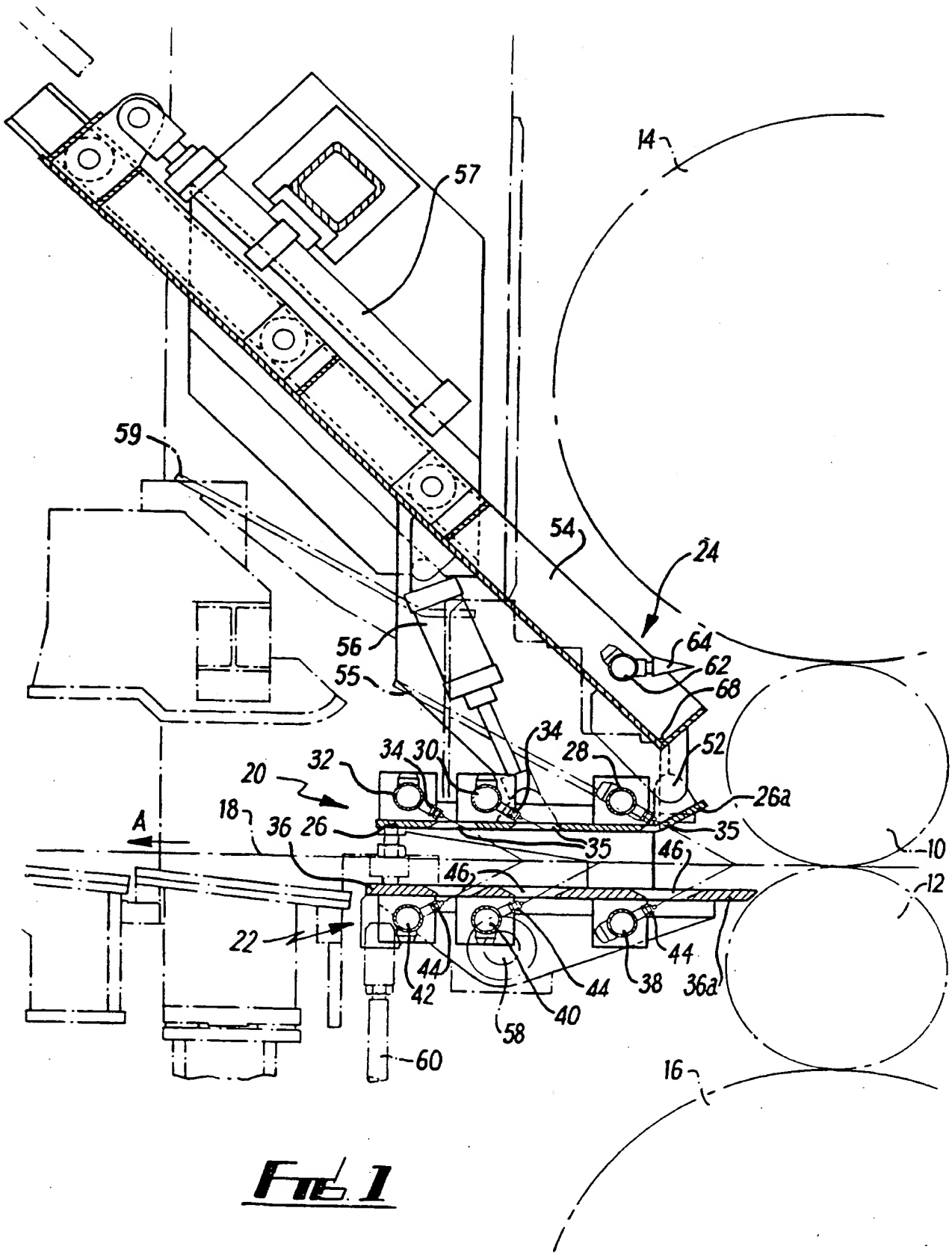

FIG. 1

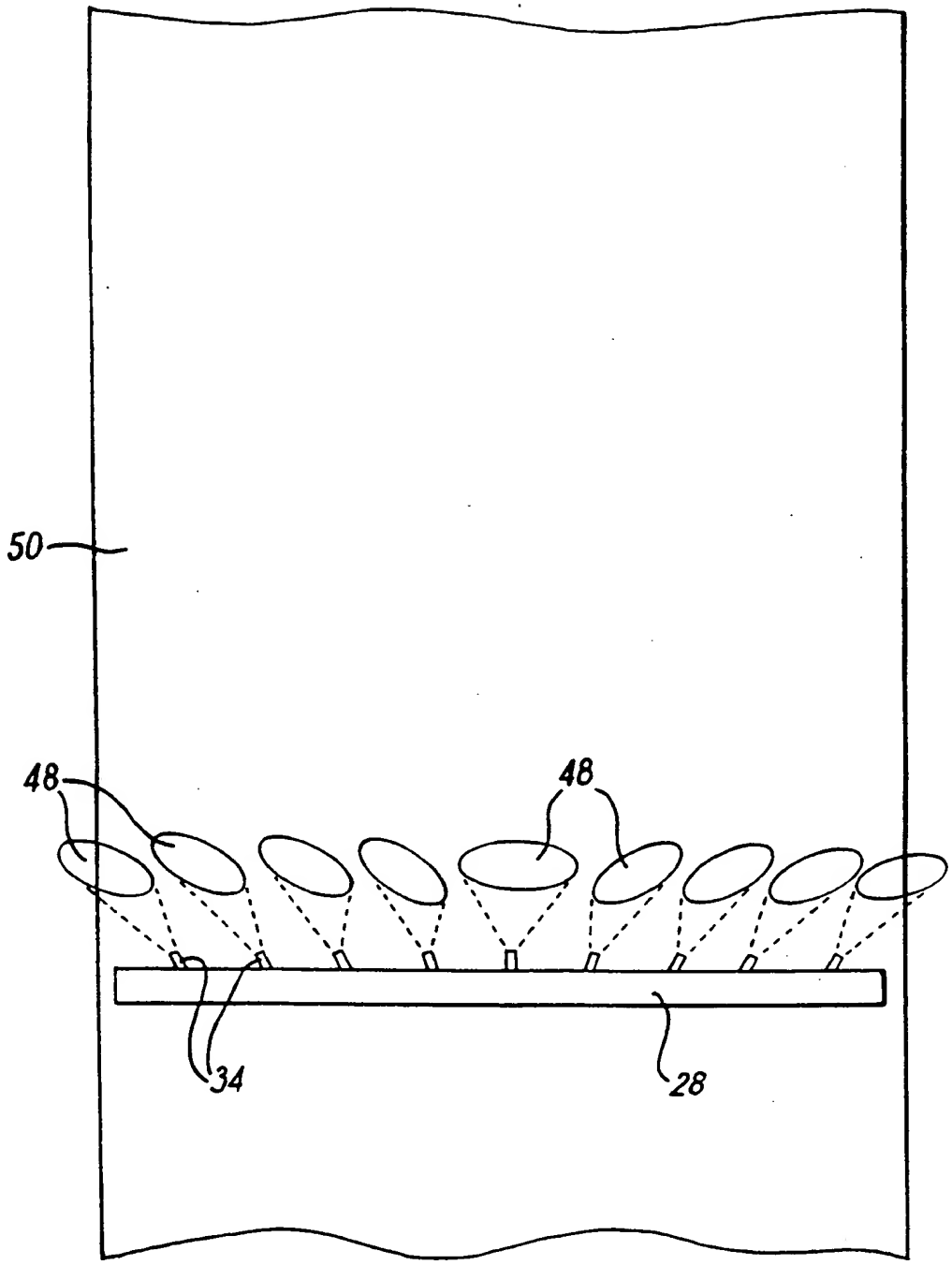

FIG. 2

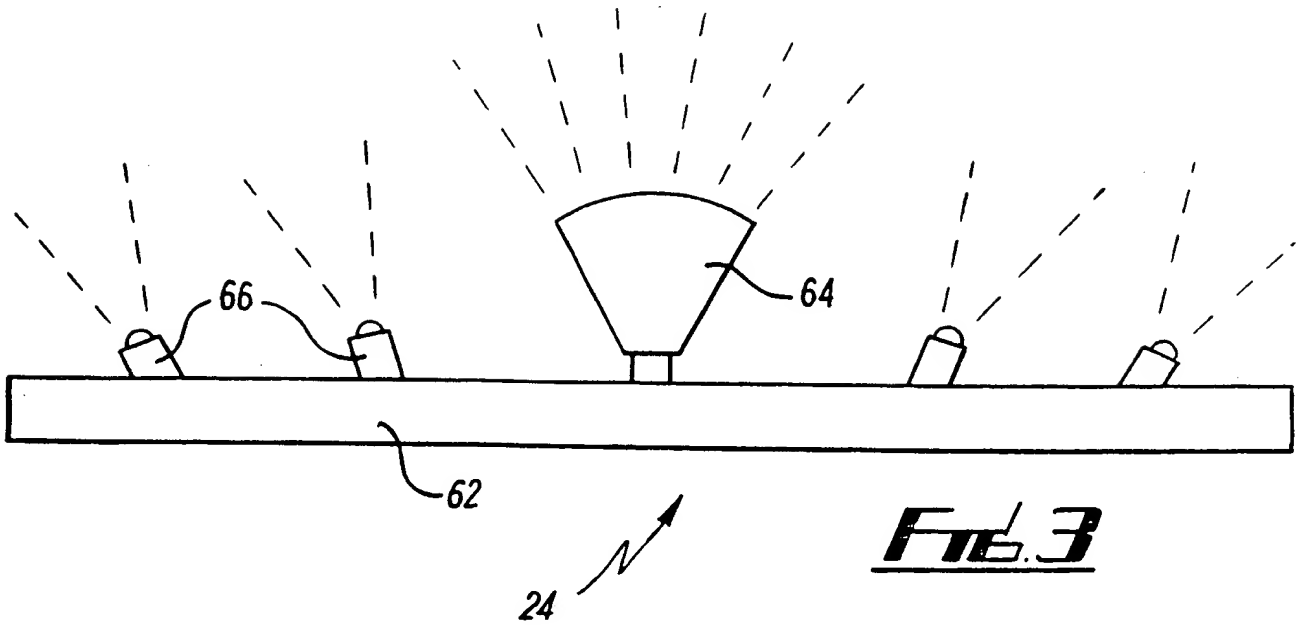

FIG. 3

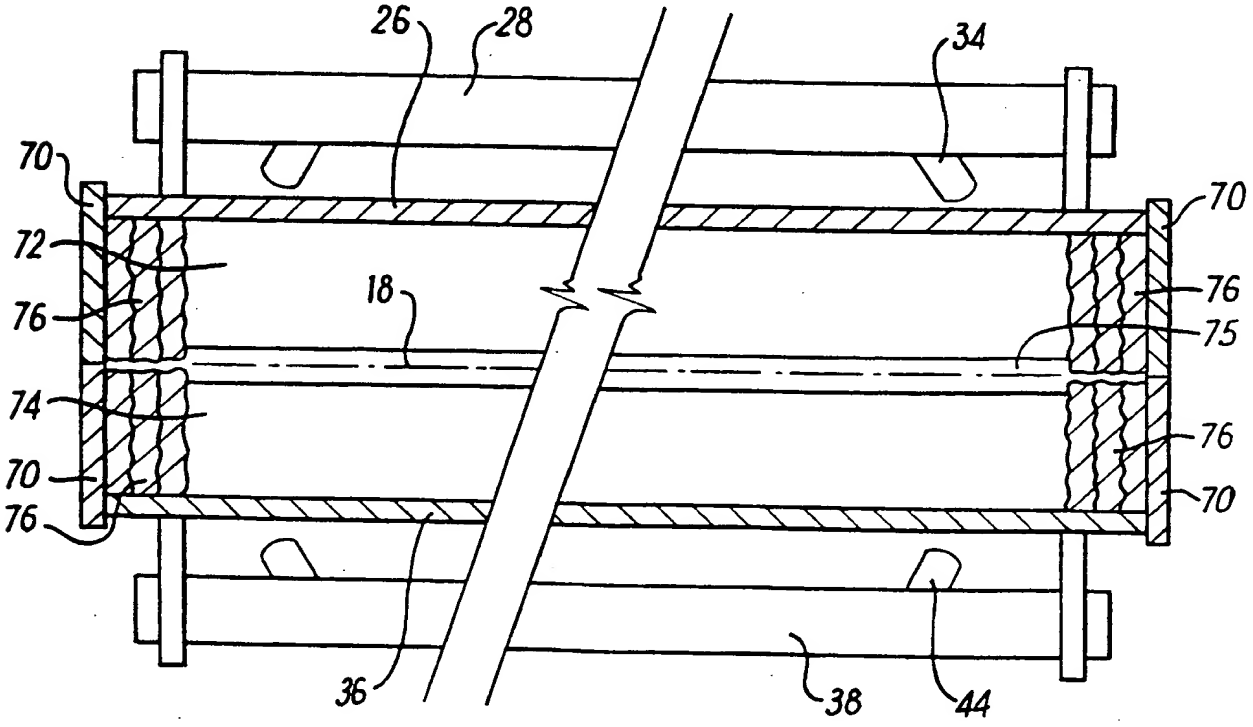

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 94/01774

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B21B45/02 B21B27/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 4, no. 53 (M-008) 19 April 1980 & JP,A,55 022 434 (HITACHI) 18 February 1980 see abstract	1,2,4,7, 9,11
A	---	5,12
X	GB,A,2 111 885 (WEAN UNITED INC) 13 July 1983 see page 2 - page 4; figures 2,5-10	1,2,4, 11,12

X	US,A,3 192 752 (DOWD ET AL.) 6 July 1965 see column 3 - column 4; figures 1-4	1,2,4
A	---	3,5,7,9, 10,13
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 November 1994	29. 11. 94

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 601 112 (KUSH ET AL.) 22 July 1986 see column 3; figures 1,1A	1,2,4
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X	PATENT ABSTRACTS OF JAPAN vol. 8, no. 132 (M-303) 20 June 1984 & JP,A,59 033 022 (HITACHI SEISAKUSHO) 22 February 1984 see abstract	1,2
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A	PATENT ABSTRACTS OF JAPAN vol. 17, no. 379 (M-1447) 16 July 1993 & JP,A,05 069 028 (KAWASAKI STEEL) 23 March 1993 see abstract	1-4,13

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		JP-A- 58110115	30-06-83
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US-A-4601112	22-07-86	NONE	